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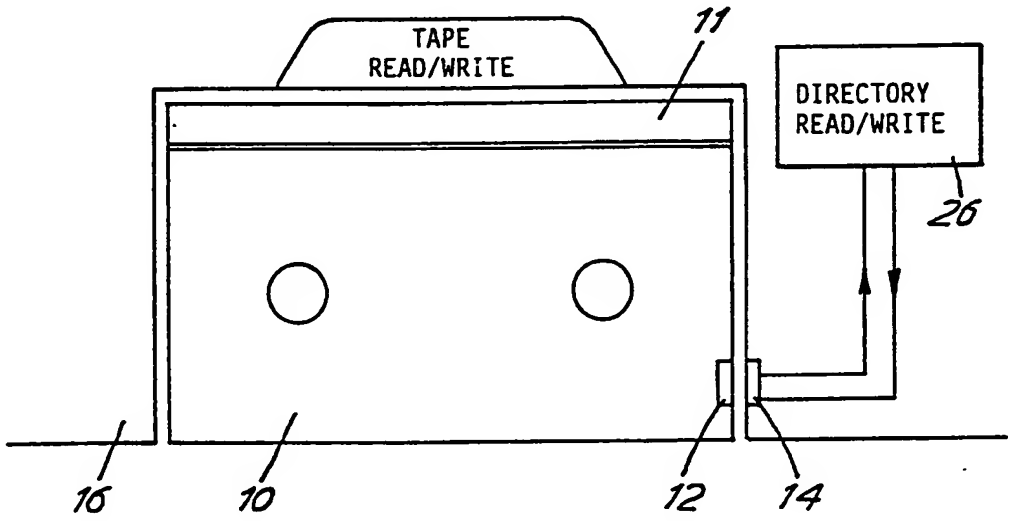
(54) Title: CASSETTE FOR SEQUENTIAL ACCESS RECORDING MEDIUM AND APPARATUS FOR USE THEREWITH



(57) Abstract

The cassette (10) containing the sequential access recording medium, such as magnetic tape, has as a separate storage device (12) embedded in the cassette casing. A directory for information stored on the tape is held in the separate storage device (12) which comprises a non-volatile random access memory and associated microprocessor. When the cassette (10) is loaded into a tape transport mechanism (16), the directory is accessed by an inductive coupling (14) or electrical contact pads, under the control of the associated microprocessor. Directory data from the storage device can be used to control the tape transport, through a separate microprocessor device. Directory information may be obtained by interactive dialogue with the user, or as supplementary information accompanying a data file or program to be stored.

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CASSETTE FOR SEQUENTIAL ACCESS RECORDING MEDIUM AND APPARATUS FOR USE THEREWITH

The present invention relates to a cassette for magnetic tape or other sequential access storage medium and recording and/or playback apparatus for use with the cassette.

The invention is applicable to read and/or write media storing computer data and program files and media storing other digital or analog information.

For efficiently organised information storage, it is desirable to have what will be referred to generically herein as a directory, that is to say data indicating the location on the storage medium of individual items of information on the medium, such items being data or program files, so-called tracks on audio tape, video frame sequences, and so on.

On disc-based storage media, for example hard or floppy computer magnetic discs or optical-reading audio compact discs, it is practical to reserve part of the storage area on the disc for a directory. Access times between sectors and tracks are relatively short compared with other storage media, allowing the directory to be easily and rapidly located. For re-writeable media, it is also practical to update the information stored in the directory each time a new item of information is recorded or a current one modified.

With magnetic tape or similar sequential access media it is still possible to have the directory on the tape e.g. at the beginning of the tape. However a number of problems arise. It becomes distinctly impractical to access and update the directory after recording new material at a physical location

which may be some distance, and hence a substantial spooling time into the tape. The only practical method of operation with a directory at the beginning of the tape is to evolve a working practice whereby all tapes are rewound before removal. At the start of operations, the tape is loaded and the directory information read into a controlling microprocessor; this copy can be updated as items are added to the tape with the updated directory being written back onto the tape following rewinding and prior to removal. A problem with this method is that, when information is to be stored near the end of the tape, a lot of time is wasted while the tape is spooled forward to the desired location, then rewound to store the updated directory.

A more practical and efficient storage routine could be achieved if it were possible to remove the tape cassette with the tape in the position reached after the last recording. When the tape was next loaded to store information it would be in a position to record immediately. One way of partially achieving this is to store the directory at a number of suitably spaced locations along the tape but this produces greater problems since every copy of the directory must then be updated when new items of information have been stored.

The object of the present invention is to provide an improved cassette which enables the problems discussed above to be overcome and to provide improved read and/or write apparatus for use with the cassette.

According to the present invention there is provided a cassette as defined in claim 1 below. Also according to the present invention there is further provided read and/or write apparatus for use with the cassette, as defined in claim 11.

Preferably the directory information for a sequential access medium such as magnetic tape (e.g. computer tape, audio cassette, video cassette or similar) is held in a separate storage device comprising a random access memory and associated microprocessor. Where the tape is pre-recorded the storage device may comprise a read-only memory. The directory storage device may be mechanically joined to, or incorporated within the cassette which holds the tape. It may be a separately available device to be attached to a standard tape-carrying cassette. For a re-writeable information storage medium, the directory storage device can comprise any suitable form of non-volatile read/write memory which would be accessed with the aid of the associated microprocessor.

Data communication to and from the storage device can be via electrical contact pads or using an inductive coupling. The use of a microprocessor in the storage device permits serial asynchronous communication with the random access memory, greatly reducing the number of connections required in comparison to a parallel connection. With serial communication, an inductive coupling could be used instead of direct electrical connections, the inductive coupling providing the power needed to operate the microprocessor.

The technology required for the random access data file directory store already exists in the form of electronic "smart cards" as used for electronically transferring funds. Early versions of such cards did not have a true read/write memory capability: new data was written into previously unused locations of an EPROM such that old locations could be abandoned but not re-used. However read/write cards are now available. Inductively coupled versions of such "smart cards" are also available and the same technology can be obtained in

a "TAG" or token in the shape of a coin or lozenge.

One embodiment will now be described by way of example with reference to the accompanying drawings in which:

Fig. 1 shows a magnetic tape cassette with a separate memory device embedded in the casing;

Fig. 2 shows the cassette of Fig. 1 loaded in a tape transport mechanism forming part of the read/write apparatus;

Fig. 3 is a block diagram of the memory device in or attached to the cassette;

Fig. 4 is a block diagram of the directory read/write apparatus in the tape transport mechanism; and

Fig. 5 is a flow chart illustrating how the directory system may be used.

Referring to Fig. 1, a magnetic tape cassette 10 such as may be used for information storage is shown (direction of insertion shown arrowed). The cassette contains magnetic tape engageable for tape drive in a manner well known in tape transport mechanisms. Within the mechanism a cover 11 opens to allow a magnetic head to engage the tape for reading and/or writing information on the tape. A separate storage device 12 for a directory of information held on the tape is shown embedded in the cassette body. As shown in Fig. 3 the device 12 comprises a random access, non-volatile memory 18 containing the directory, a microprocessor system 20 responsive to control signals to effect read and write operations in the memory 18, a microprocessor port 22 operating in serial or parallel and an interface device 24

which connects to the tape transport mechanism 16 and includes an inductive coupling coil. The memory 18 can be a RAM (as shown) with a small back-up battery to render it non-volatile. The use of an EPROM or EEPROM as the memory is not excluded.

The cassette 10 is shown loaded into a tape transport mechanism 16 in Fig. 2. The side wall of the cassette aperture is fitted with a coil 14 for inductively coupled communication with the directory storage device 12. The inductive coupling is arranged to be in operational range only when the tape 10 is loaded into the transport mechanism 16. Care must be taken to ensure that the field generated by the inductive coupling does not affect the magnetic information on the tape. A screen can be provided in the cassette for this purpose. Alternatively direct electrical connection could be made via contact pads making engagement when the cassette was inserted.

The directory read/write apparatus 26 in the tape transport mechanism 16 is shown in Fig. 4. The coil 14 or other interface device is connected, via a microprocessor port 28, to a controlling microprocessor 30. A control output 32 connects the microprocessor 30 to the tape transport control mechanism. A data input 34 receives information to be stored in the directory, either from a user interface such as a keyboard or automatically from a programme labelling system of the type described below.

Information received by the controlling microprocessor 30, either read from the directory on the cassette or received on the data input 32, may be displayed on a display device 36 such as a VDU or liquid crystal display.

In operation, the directory information is read from the

storage device 12 by the controlling microprocessor 30 forming part of the read/write apparatus 26 which controls the tape transport mechanism, the information being used to create a menu for the user. Such a menu may be as shown in Table 1 below:

TABLE 1

Tape: Albert's tape 4

Item	Source	Time and Date Recorded	Length
Rock Concert	BBC1	13:18 - 24th July 95	24 mins Stereo
Gardening	BBC2	10:34 - 25th July 95	29 mins
Soap (Episode 3)	BBC1	12:30 - 25th July 95	27 mins

Tape left 1 hr 38 mins

The above table is only an example: there may be much more data to do with encryption, copyright, expiry dates, programme history, programme type and programme details like a synopsis. For new material, the title details could be obtained by interactive dialogue with the user. This information, together with other details such as the location to be used on the tape and the recording format, is written to the directory with the directory storage device.

Fig. 5 is a flow chart illustrating how the directory system would be used:

INSERT - The user inserts the cassette into the tape transport mechanism;

READ DIRECTORY - The controlling microprocessor in the read/write apparatus reads the contents of the memory device in or on the cassette;

DISPLAY DIRECTORY - The contents of the directory are displayed in the form of a menu (as in Table 1 above);

SELECT RECORD/PLAY - The user selects whether the tape will be recorded onto or just played. If "play" is selected, the tape is simply played and no changes are made to the contents of the memory device;

ENTER PROGRAMME DETAILS - If "record" is selected, the user may enter programme details by way of a keyboard or the details may be obtained from a labelling system accompanying the programme;

RECORD PROGRAMME - The selected programme is recorded onto the cassette tape; and

STORE DETAILS IN DIRECTORY - The details of the programme being recorded are written into the memory device on or in the cassette.

This system allows for a fully updated directory to be available, regardless of the tape location passing the magnetic read/write head. There is no need to rewind the tape to over-write the old directory information. The cassette may safely be removed from the transport mechanism with the tape in position to record the next item of information, providing

a saving in time. The wear on the tape caused by repeated forwarding and rewinding, with the consequent drop in reliability is thus reduced.

A typical size of directory store may be 8K bytes and as a consequence, the number of separate items of information which could be described in the available amount of bit storage might be limited. For a tape used to store many short programmes or data files, the directory store might be filled before all the tape was used. A larger directory store might be used for such applications.

In many cases, it is envisaged that some of the directory information such as the title could be made available as supplementary information accompanying the programme or data file which is to be recorded on tape. For example, with a radio programme, the title could be obtained from the RDS (radio data service) system without user intervention. For a television programme delivered by the system known as Downloading the title could be obtained by an accompanying data service. If the programme or data file is to be recorded in encrypted form then the access parameters could optionally be included in the directory store.

Claims

1. A cassette for a sequential access storage medium comprising a housing within which the medium is held and a separate storage device carried by the housing for storing a directory which may be at least read irrespective of the storage medium location which is available for reading or writing, characterised in that the storage device comprises a memory and a microprocessor responsive to commands to control the reading and/or writing of data in the memory.

2. A cassette according to claim 1, wherein the sequential access storage medium is magnetic tape.

3. A cassette according to claim 1 or 2, in which the memory is a non-volatile read/write memory.

4. A cassette according to claim 1 or 2, in which the memory is a non-volatile read-only memory.

5. A cassette according to any of claims 1 to 3, in which the memory is a random access memory.

6. A cassette according to any previous claim, wherein the storage device is accessed via electrical contact pads.

7. A cassette according to any of claims 1 to 5, wherein the storage device is accessed via an inductive coupling.

8. A cassette according to claim 7, having means to shield the storage medium from the inductive coupling field.

9. A cassette according to any of claims 1 to 6, in which data is written to and/or read from the directory by bit

parallel transfer.

10. A cassette according to any of claims 1 to 8, in which data is written to and/or read from the directory by bit serial transfer.

11. Read and/or write apparatus for a sequential access storage medium, comprising means for receiving a cassette holding the medium, a transport mechanism for transporting the medium, a transducer for reading and/or writing information on the medium, and means independent of the transducer for at least reading a directory from a directory storage device carried by the cassette, including means which couple the apparatus to the directory storage device when the cassette is in the receiving means, characterised in that the said means independent of the transducer is adapted to send control signals to the directory storage device, in addition to sending and/or receiving information signals, to control the reading and/or writing of information in the directory storage device.

12. Apparatus according to claim 11, wherein the transducer is a magnetic head for reading and/or writing on magnetic tape.

13. Apparatus according to claim 11 or 12, wherein the means which couple the apparatus to the storage device comprise electrical contact pads.

14. Apparatus according to claim 11 or 12, wherein the means which couple the apparatus to the storage device comprise a coil to provide an inductive coupling.

15. Apparatus according to any of claims 11 to 14, in which

the said means independent of the transducer may also be used for writing to the directory.

16. Apparatus according to any of claims 11 to 15, in which the directory is written to and/or read from by bit parallel transfer.

17. Apparatus according to any of claims 11 to 15, in which the directory is written to and/or read from by bit serial transfer.

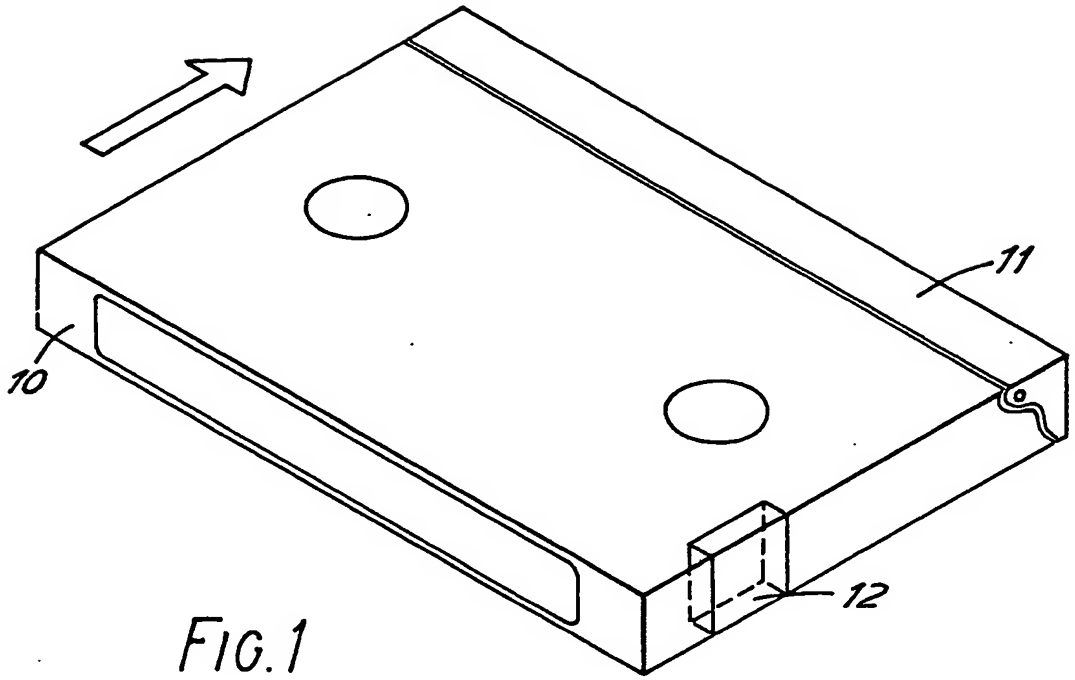

FIG. 1

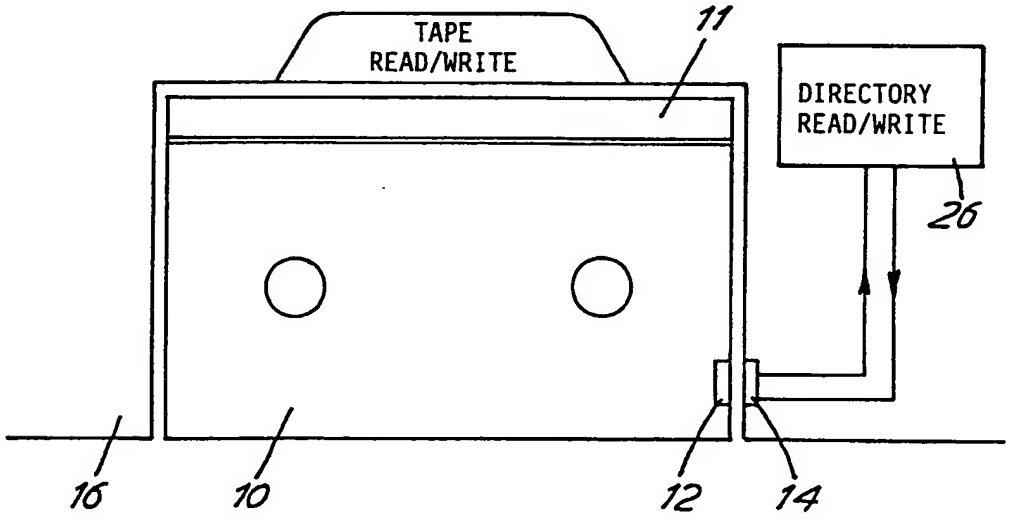

FIG. 2

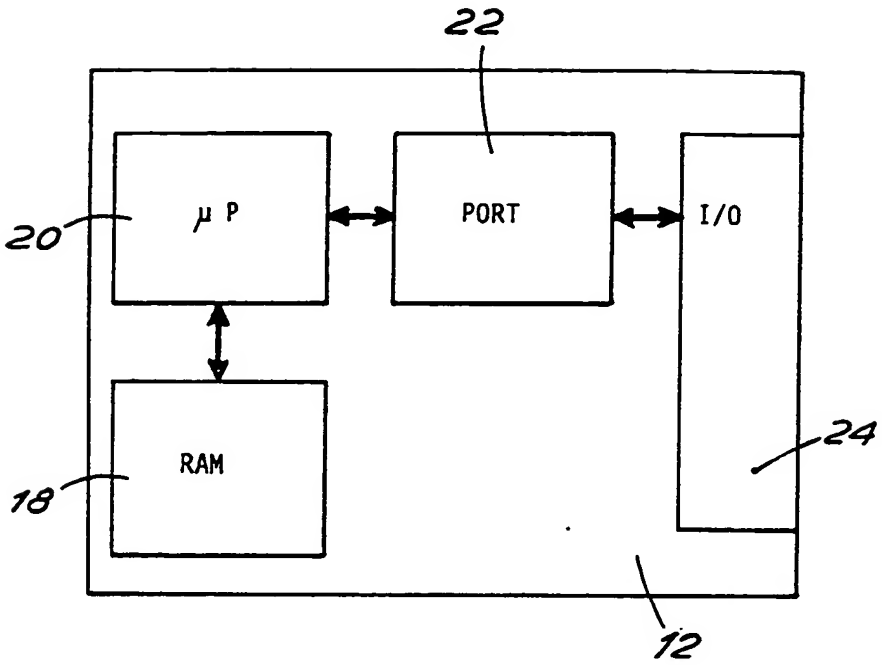
22
20
μ P
PORT
I/O
RAM
18
24
12

FIG. 3

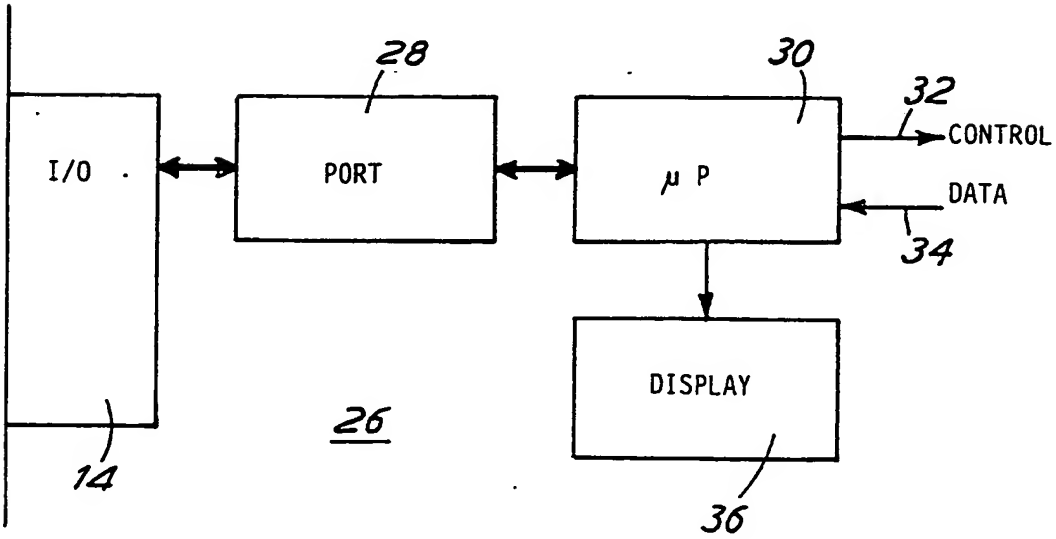
28
30
32
I/O
PORT
μ P
CONTROL
DATA
34
DISPLAY
26
14
36

FIG. 4

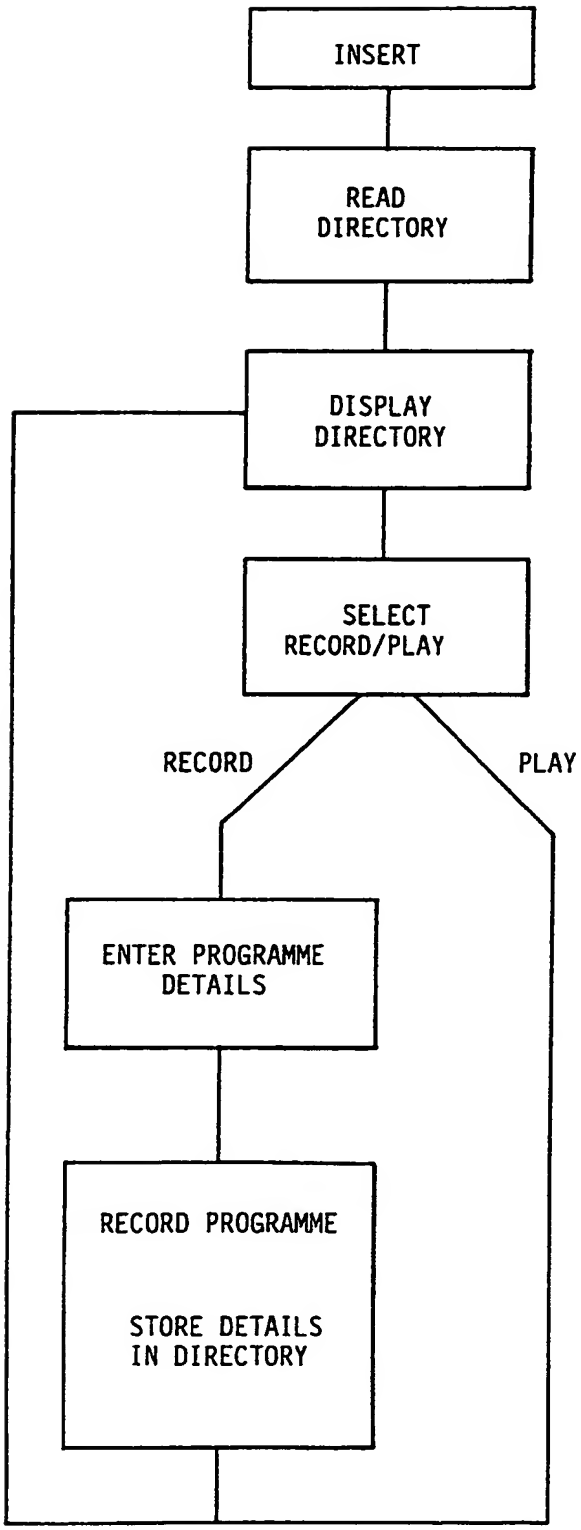
INSERT
READ DIRECTORY
DISPLAY DIRECTORY
SELECT RECORD/PLAY
RECORD
PLAY
ENTER PROGRAMME DETAILS
RECORD PROGRAMME
STORE DETAILS IN DIRECTORY

FIG.5

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 89/00393

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 4 G11B23/04 ; G11B23/30 ; G11B15/00 ; G11B15/02

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 4	G11B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X	PATENT ABSTRACTS OF JAPAN vol. 11, no. 391 (P-649)(2838) 22 December 1987, & JP-A-62 157391 (SONY CORP.) 13 July 1987, * see the whole document *	1, 2, 7, 10-12, 14, 15, 17
Y	---	3-6, 13
X	JP-A-62 285289 *TERUO TAKEUCHI* 11 December 1987 &PATENT ABSTRACTS OF JAPAN Vol. 12, no. 175 *P-707*,*3022* 25 May 1988, * see Abstract of & JP-A-62 285289 *	1, 2, 11, 12, 15
X	---	
X	FR,A,2461299 (TELEDIFFUSION DE FRANCE ET AL.) 30 January 1981 see page 3, line 32 - page 4, line 27 see page 7, line 1 - page 8, line 36; figures 3, 5	1-3, 9, 11, 12, 15, 16
A	---	6, 13
	-/--	

* Special categories of cited documents : [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
27 JUNE 1989	11. 07. 89
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	DAALMANS F.J.

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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
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Y	EP,A,0029946 (BASF A.G.) 10 June 1981 see page 6, line 20 - line 23 see page 8, line 14 - page 9, line 8 see page 18, line 4 - page 19, line 21	3
A		1, 2, 4, 5, 11, 12, 15
Y	PATENT ABSTRACTS OF JAPAN vol. 9, no. 157 (P-369)(1880) 02 July 1985, & JP-A-60 032177 (MATSUSHITA DENKI SANGYO K.K.) 19 February 1985, * see the whole document *	3
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Y	BE,A,879620 (STAAR S.A.) 15 February 1980 see page 3, line 10 - page 11, line 18	3, 4, 6, 13
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A		1, 11
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Y	JP-A-62 256289 *TOSHIBA K.K.*07 November 1987, &PATENT ABSTRACTS OF JAPAN vol. 12, no. 136 *P-694*,*2983* 26 April 1988, * see Abstract of & JP-A-62 256289 *	3

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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
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P,X	EP,A,0266101 (HITACHI MAXELL LTD.) 04 May 1988 see page 4, line 21 - line 46 see page 6, line 13 - line 48	1, 3, 4, 9, 11, 15, 16
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P,Y	PATENT ABSTRACTS OF JAPAN vol. 12, no. 123 (P-690)(2970) 16 April 1988, & JP-A-62 246193 (NEC CORP.) 27 October 1987, * see the whole document *	3, 5

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/GB 89/00393

SA 28137

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 27/06/89

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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		BE-A-	871596	15-02-79
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		CH-A-	640969	31-01-84
		AT-B-	376514	26-11-84
		BE-A-	871690	15-02-79
		FR-A,B	2440056	23-05-80
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		BE-A-	886928	16-04-81
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